

# Prevalence and Treatment Patterns of Sleep Disorders in the Under 20 Population: analysis using a national health insurance claims database

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**Objectives:** Child and adolescent sleep is an important factor for brain and physical development. Therefore, it is necessary to investigate the prevalence of sleep disorders and nonorganic sleep disorders in children and adolescents and determine the type of utilization of medical institutions. This study analyzed the prevalence and type of medical institutions in Korean children and adolescents with sleep disorders and nonorganic sleep disorders.

**Methods:** This study used data recorded in the Health Insurance Review and Assessment-National Patient Sample (HIRA-NPS) database from 2010 to 2017. Details of medical institution type and patient's sex, age, and treatment type were extracted for patients younger than 20 years with sleep disorders and nonorganic sleep disorders.

**Results:** Among 2,536,478 patients under age 20, we identified 3,772 patients with sleep disorders or nonorganic sleep disorders. From 2010 to 2017, the prevalence of sleep disorders in children and adolescents was 0.07% to 0.09%. The utilization rate of Korean medical institutions was 30.47%. The prevalence of nonorganic sleep disorders and the utilization rate of Korean medical institutions were 0.06% to 0.08% and 45.99%, respectively.

**Conclusion:** The prevalence of sleep disorders and nonorganic sleep disorders in the under-20 population was 0.14% to 0.16%. More than 70% of patients with nonorganic sleep disorder who were younger than 9 years used Korean medical institutions.

**Keywords:** sleep disorders, nonorganic sleep disorders, korean medicine, herbal medicine, acupuncture

## INTRODUCTION

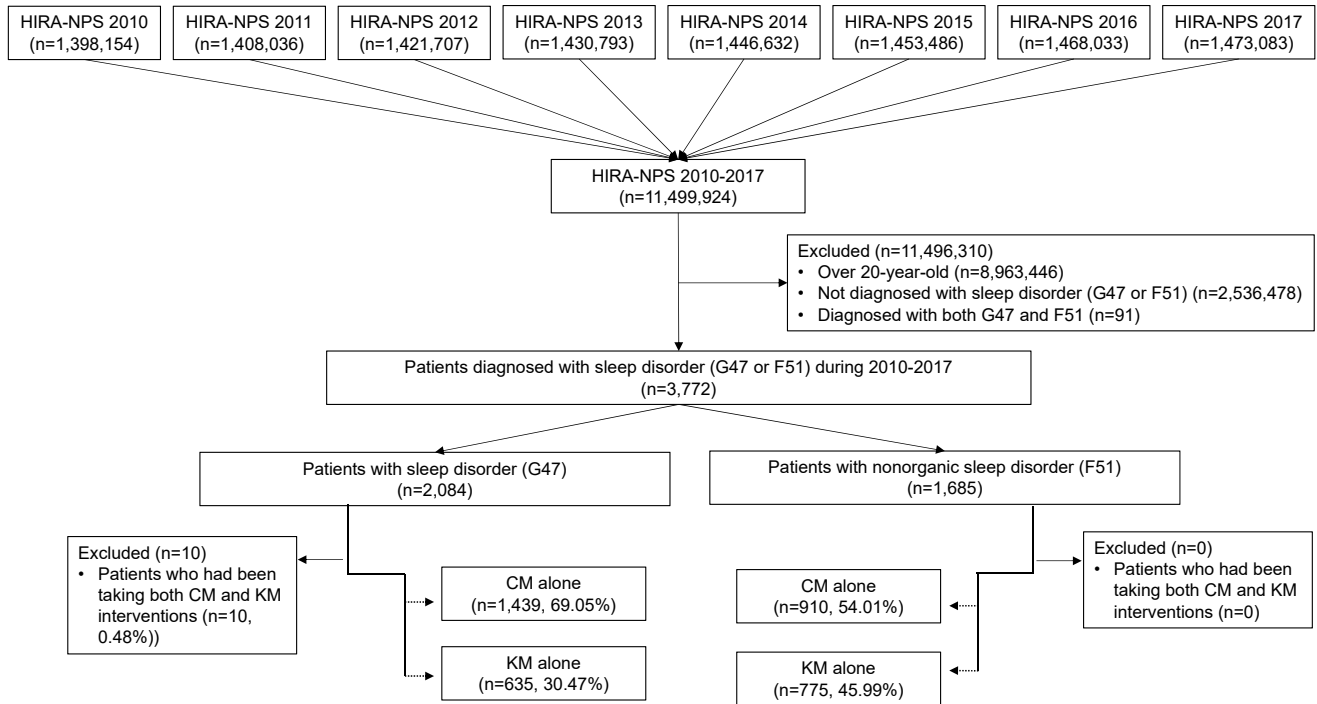
Infancy is a crucial period for establishing sleep patterns [1]. Sleep is necessary for proper brain and body development [2]. Sleep-wake control develops rapidly during the first year of life and stabilizes with maturity after 2 years of age [3]. Newborns sleep for 11-14 hours, whereas adolescents sleep for 9-11 hours [4]. As sleep patterns change continuously, the symptoms and diseases associated with sleep disorders in children and adults can differ. Thus, in children and adolescents, obstructive sleep apnea, somnambulism, delayed sleep phase syndrome, para-

somnias, night terrors, nightmares, and behavioral insomnia are more common than it is in adults [5]. In contrast, the prevalence of sleep-related disorders is approximately 43%, and sleep disorders tend to persist throughout childhood and adolescence [6]. Sleep disorders in children and adolescents affect their development and function in various areas, including attention, behavior, and learning, and induce various clinical symptoms, such as growth failure, psychiatric disorders, learning disorders, and cardiovascular disorders [7].

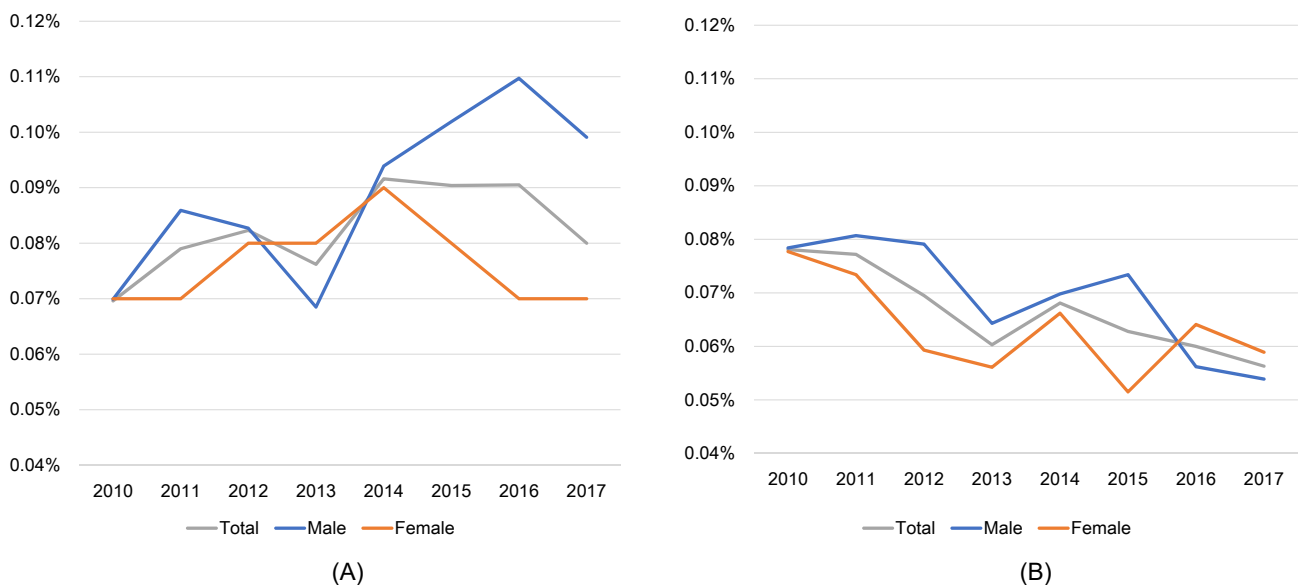
Despite the high prevalence and significant impact of sleep problems in children and adolescents, few studies have exam-

ined the prevalence of sleep disorders in children and adolescents, especially with regard to non-pharmacological treatments in the Republic of Korea (ROK) [8]. Clinical practice guidelines for the non-pharmacological treatment of sleep disorders in adults are available and include recommendations for acupuncture, herbal medicine, and moxibustion treatment for adults

with insomnia [9]. However, information on clinical practice guidelines for the non-pharmacological treatment of sleep disorders in children and adolescents is limited. In the ROK, Korean medicine is one of the non-pharmacological treatments with coverage under the National Health Insurance [10]. Korean medicine includes acupuncture, herbal medicine, moxibustion,



**Figure 1.** Patients selection process.



**Figure 2.** Prevalence of sleep disorders (A) and nonorganic sleep disorders (B) among children aged 0-19.

and cupping, and the type of non-pharmacological treatment availed for child and adolescent sleep disorder patients can be identified from the insurance data.

This study investigated the prevalence of sleep disorders and nonorganic sleep disorders in the ROK in individuals aged 0-19 years in a nationally representative population and evaluated the characteristics and medical information, such as the treatment type, according to medical utilization based on the diagnosis.

## MATERIALS AND METHODS

### 1. Data source

In the ROK, medical insurance is compulsory, and 98% of the population is covered by medical insurance. This study used data obtained from the national health insurance database – the Health Insurance Review and Assessment-National Patient Sample (HIRA-NPS) – for 2010-2017 that is maintained by the ROK Health Insurance Review and Assessment (HIRA). The data set provided by the HIRA extracts a sample corresponding to 3% of the total population by stratifying the patient-level system according to the 5-year-old unit, and provides treatment and prescription details included in insurance for 1 year. The HIRA dataset provides health information for new samples each year. In this study, eight yearly datasets were combined into a single dataset and analyzed. The data set comprises the patient basic information, treatment details, information from the Korean Standard Classification of Diseases (KCD), and the prescription details [11]. The KCD code is a revised version of the International Classification of Diseases Codes.

### 2. Study population

Outpatient and inpatient patients with a sleep disorder diagnosis code according to the KCD code were included in the study population. The sleep disorder diagnosis codes include sleep disorders (G47) and nonorganic sleep disorders (F51) and the sub-codes. Patients diagnosed with both sleep disorders and nonorganic sleep disorders were excluded as were those who used both Korean medicine and conventional medicine or were older than 20 years.

**Table 1. Prevalence of sleep disorders and nonorganic sleep disorders in Korean children aged 0-19 years**

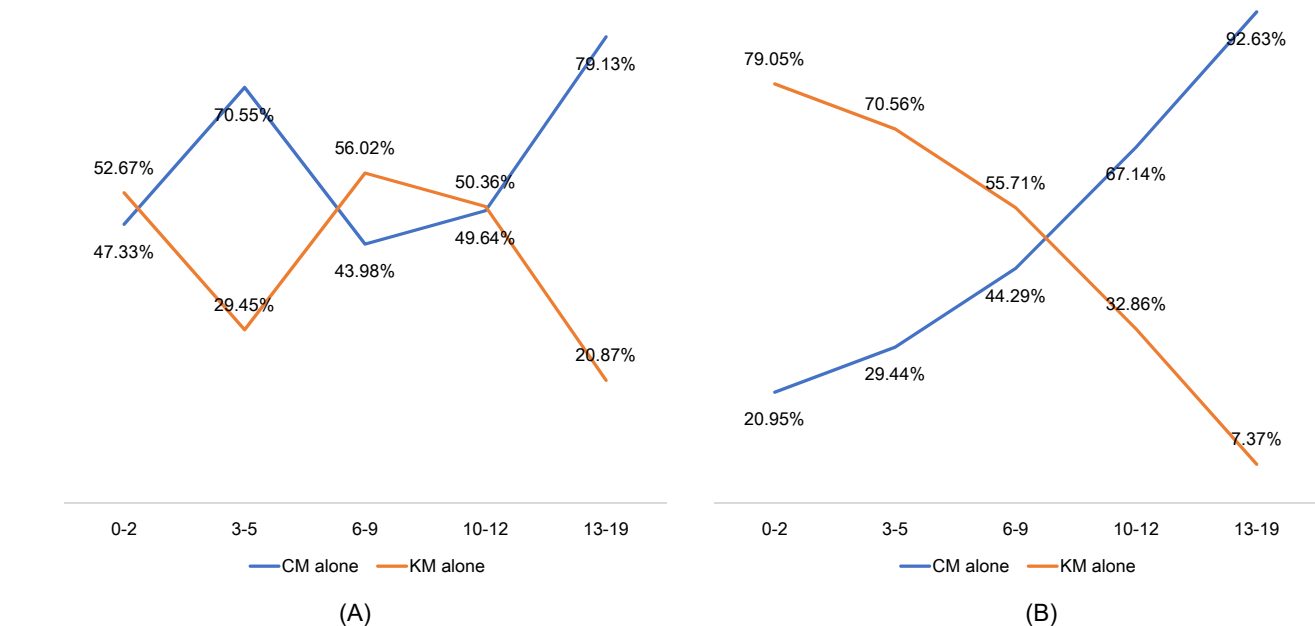
Year	Total (N)						Sleep disorders						Nonorganic sleep disorders					
	Total		Male		Female		Total		Male		Female		Total		Male		Female	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Total	2,536,478	0.08	1,307,636	0.08	1,228,842	0.08	2,074	0.08	1,140	0.09	934	0.08	1,685	0.07	907	0.07	778	0.06
2010	339,323	0.07	175,921	0.07	163,402	0.07	228	0.07	120	0.07	108	0.07	260	0.08	136	0.08	124	0.08
2011	332,942	0.08	172,270	0.08	160,672	0.08	261	0.08	148	0.09	113	0.07	254	0.08	137	0.08	117	0.07
2012	327,936	0.08	169,369	0.08	158,567	0.08	269	0.08	140	0.08	129	0.08	228	0.07	134	0.08	94	0.06
2013	320,049	0.08	164,930	0.08	155,119	0.08	244	0.08	113	0.07	131	0.08	193	0.06	106	0.06	87	0.06
2014	314,441	0.09	161,929	0.09	152,512	0.09	281	0.09	147	0.09	134	0.09	214	0.07	113	0.07	101	0.07
2015	307,389	0.09	158,003	0.09	149,386	0.09	272	0.09	157	0.10	115	0.08	192	0.06	115	0.07	77	0.05
2016	301,505	0.09	154,898	0.09	146,607	0.09	271	0.09	168	0.11	103	0.07	181	0.06	87	0.06	94	0.06
2017	292,893	0.08	150,316	0.08	142,577	0.08	248	0.08	147	0.10	101	0.07	163	0.06	79	0.05	84	0.06

### 3. Study variables

The study variables included sex, age, medical institution, outpatient use frequency, treatment pattern, and medical cost. Sleep disorder is defined by the following KCD code: insomnia (G47.0); hypersomnia (G47.1); disorders of the sleep-wake schedule (G47.2); sleep apnea (G47.3); narcolepsy and cataplexy (G47.4); other sleep disorders (G47.8); sleep disorder, unspecified (G47.9); nonorganic insomnia (F51.0); nonorganic hypersomnia (F51.1); nonorganic disorder of the sleep-wake schedule (F51.2); somnambulism (F51.3); night terrors (F51.4); nightmares (F51.5); other nonorganic sleep disorders (F51.8); and nonorganic sleep disorder, unspecified (F51.9). Korean medicine alone users were defined as patients who did not visit conventional medical institutions in the year among patients treated at Korean medical institutions, and conventional medical alone users were defined as patients who did not visit Korean medical institutions in the year.

### 4. Statistical analysis

Statistical analysis was performed using R version 4.0.3 and SAS 9.4 (SAS Institute, Cary). The descriptive statistics are expressed as the mean, number, and percentage.



**Figure 3.** Proportion of types of medical utilization by age in children and adolescents with sleep disorders (A) and nonorganic sleep disorders (B).

## RESULTS

The 2010-2017 HIRA dataset comprises information on 11,499,924 patients, of which 2,536,478 (22.06%) were younger than 20 years. After excluding those who were diagnosed with both sleep and nonorganic sleep disorders, 3,772 participants were selected of whom 2,084 and 1,685 patients were diagnosed with sleep disorders and nonorganic sleep disorders, respectively. Among the patients diagnosed with sleep disorder, 1,439 (69.05%) used conventional medicine, 635 (30.47%) used Korean medicine, and 10 (0.48%) used both conventional medicine and Korean medicine. Among the patients who were diagnosed with nonorganic sleep disorders, 910 (54.01%) and 775 (45.99%) used conventional and Korean medicine, respectively. Fig. 1 shows the detailed patient selection process.

The prevalence of sleep disorders, including nonorganic sleep disorders, in children and adolescent patients from 2010 to 2017 was 0.14-0.16%. Furthermore, the prevalence of sleep disorders and nonorganic sleep disorders in children and adolescents from 2010 to 2017 was 0.07-0.09% and 0.06-0.08%, respectively (Fig. 2, Table 1).

### 1. Sleep disorder

A higher proportion of sleep disorder patients aged 0-2 and 6-12 years used Korean medicine, whereas more sleep disorder

patients aged 3-5 and 13-19 years used conventional medicine (Fig. 3). Table 2 and 3 list the sociodemographic characteristics and treatment types of patients with sleep disorders according to the medical institution. More men with sleep disorders (57.82%) used conventional medicine than women, whereas more women with sleep disorders (51.50%) used Korean medicine compared with men. Most of the patients with sleep disorders

who used Korean medicine were diagnosed with insomnia, whereas participants with sleep disorders who used conventional medicine were diagnosed with insomnia, sleep apnea, or unspecified sleep disorder.

Most patients with sleep disorder who used Korean medicine received acupuncture (mean 4.96 acupuncture treatments in a mean follow-up period of 199.40 days). The average num-

**Table 2.** Characteristics of patients with sleep disorders according to the utilization of conventional and Korean medicine

	Total		CM alone		KM alone	
	n	%	n	%	n	%
Total	2,074	100.00	1,439	69.38	635	30.62
Age						
0-2	281	13.55	133	9.24	148	23.31
3-5	163	7.86	115	7.99	48	7.56
6-9	166	8.00	73	5.07	93	14.65
10-12	137	6.61	68	4.73	69	10.87
13-19	1,327	63.98	1,050	72.97	277	43.62
Gender						
Male	1,140	54.97	832	57.82	308	48.50
Female	934	45.03	607	42.18	327	51.50
Use of outpatient service						
Mean ± sd	2.32 ± 2.84		2.16 ± 2.37		2.69 ± 3.66	
Median (Q1, Q3)	1 (1, 31)		1 (0, 27)		1 (1, 31)	
Follow-up period (day)						
Mean ± sd	196.73 ± 109.12		195.19 ± 110.07		200.22 ± 106.94	
Median (Q1, Q3)	195 (107, 301)		194 (99.5, 299)		197 (115.5, 302.5)	
Diagnostic code						
Insomnias	903	43.54	452	31.41	451	71.02
Hypersomnias	88	4.24	79	5.49	9	1.42
Disorders of the sleep-wake schedule	21	1.01	19	1.32	2	0.31
Sleep apnoea	408	19.67	403	28.01	5	0.79
Narcolepsy and cataplexy	117	5.64	116	8.06	1	0.16
Other sleep disorders	169	8.15	114	7.92	55	8.66
Sleep disorder, unspecified	368	17.74	256	17.79	112	17.64
Year						
2010	228	10.99	154	10.70	74	11.65
2011	261	12.58	180	12.51	81	12.76
2012	269	12.97	187	13.00	82	12.91
2013	244	11.76	173	12.02	71	11.18
2014	281	13.55	203	14.11	78	12.28
2015	272	13.11	198	13.76	74	11.65
2016	271	13.07	186	12.93	85	13.39
2017	248	11.96	158	10.98	90	14.17

**Table 3. Treatment type of patients with sleep disorders according to the utilization of Korean medicine**

	Acupuncture			Herbal medicine			Moxibustion			Cupping		
	n (%)	N of prescription mean ± sd	Follow-up period mean ± sd	n (%)	N of prescription mean ± sd	Follow-up period mean ± sd	n (%)	N of prescription mean ± sd	Follow-up period mean ± sd	n (%)	N of prescription mean ± sd	Follow-up period mean ± sd
Total	553 (100.0)	4.96 ± 8.66	199.40 ± 107.55	71 (100.0)	1.69 ± 1.83	215.76 ± 105.07	149 (100.0)	3.20 ± 4.93	190.98 ± 112.05	79 (100.0)	4.04 ± 5.50	200.98 ± 105.64
Age												
0-2	132 (23.87)	2.64 ± 3.84	195.71 ± 108.45	14 (19.72)	2.50 ± 3.70	202.43 ± 89.56	8 (5.37)	2.88 ± 3.36	90.88 ± 107.40	8 (10.13)	2.25 ± 1.75	173.63 ± 112.25
3-5	41 (7.41)	4.37 ± 5.95	190.24 ± 99.59	7 (9.86)	1.43 ± 0.54	139.43 ± 84.14	9 (6.04)	1.56 ± 1.01	185.44 ± 131.28	3 (3.80)	4.67 ± 5.51	159.00 ± 130.93
6-9	80 (14.47)	4.78 ± 6.62	217.54 ± 110.76	11 (15.49)	1.27 ± 0.47	265.27 ± 84.06	17 (11.41)	2.24 ± 2.05	178.94 ± 122.96	5 (6.33)	5.60 ± 9.74	247.00 ± 106.97
10-12	60 (10.85)	4.95 ± 7.59	208.55 ± 155.49	12 (16.90)	1.58 ± 1.00	208.92 ± 133.01	23 (15.44)	3.65 ± 5.74	230.26 ± 109.39	7 (8.86)	2.57 ± 2.23	211.00 ± 143.82
13-19	240 (43.40)	6.39 ± 11.21	194.66 ± 105.28	27 (38.03)	1.56 ± 1.09	225.33 ± 105.16	92 (61.74)	3.46 ± 5.41	192.63 ± 105.64	56 (70.89)	4.30 ± 5.74	201.77 ± 100.50
Gender												
Male	271 (49.01)	4.52 ± 6.91	203.69 ± 106.13	24 (33.80)	1.92 ± 2.67	216.54 ± 109.69	60 (40.27)	2.92 ± 4.00	180.17 ± 112.65	47 (59.49)	3.30 ± 3.92	185.09 ± 106.21
Female	282 (50.99)	5.37 ± 10.06	195.28 ± 108.92	47 (66.20)	1.57 ± 1.23	215.36 ± 103.85	89 (59.73)	3.39 ± 5.48	198.27 ± 111.68	32 (40.51)	5.13 ± 7.17	224.31 ± 101.97
Diagnostic code												
Insomnias	392 (70.89)	5.31 ± 9.68	203.20 ± 106.70	53 (74.65)	1.81 ± 2.09	216.32 ± 103.35	120 (80.54)	3.20 ± 4.99	190.31 ± 113.31	57 (72.15)	4.07 ± 5.48	205.39 ± 107.39
Hypersomnias	5 (0.90)	3.60 ± 3.58	244.20 ± 103.51	0 (0.00)			2 (1.34)	2.50 ± 2.12	199.00 ± 104.65	1 (1.27)	1	273
Disorders of the sleep-wake schedule	2 (0.36)	11.50 ± 12.02	154.00 ± 65.05	0 (0.00)			1 (0.67)	1.00	200.00	0 (0.00)		
Sleep apnoea	5 (0.90)	1.80 ± 1.30	294.80 ± 55.39	0 (0.00)			0 (0.00)			1 (1.27)	1	352
Narcolepsy and cataplexy	1 (0.18)	3.00	65.00	0 (0.00)			0 (0.00)			0 (0.00)		

**Table 3. Continued**

	Acupuncture			Herbal medicine			Moxibustion			Cupping		
	n (%)	N of prescription mean ± sd	Follow-up period mean ± sd	n (%)	N of prescription mean ± sd	Follow-up period mean ± sd	n (%)	N of prescription mean ± sd	Follow-up period mean ± sd	n (%)	N of prescription mean ± sd	Follow-up period mean ± sd
Other sleep disorders	49 (8.86)	4.67 ± 7.00	170.74 ± 103.86	6 (8.45)	1.33 ± 0.52	202.83 ± 87.90	8 (5.37)	1.75 ± 1.75	152.75 ± 90.59	7 (8.86)	7.57 ± 8.92	164.43 ± 92.37
Sleep disorder, unspecified	99 (17.90)	3.81 ± 4.41	193.75 ± 112.00	12 (16.90)	1.33 ± 0.65	219.75 ± 127.03	18 (12.08)	4.06 ± 5.80	211.06 ± 119.44	13 (16.46)	2.46 ± 2.30	184.15 ± 104.64
Year												
2010	64 (11.57)	5.73 ± 8.55	203.78 ± 104.42	8 (11.27)	1.63 ± 1.41	192.38 ± 103.14	14 (9.40)	2.93 ± 2.90	180.57 ± 111.97	8 (10.13)	4.88 ± 6.20	246.13 ± 94.09
2011	74 (13.38)	4.04 ± 5.02	189.89 ± 115.49	5 (7.04)	1.40 ± 0.89	274.80 ± 85.88	17 (11.41)	2.71 ± 2.66	177.00 ± 125.25	4 (5.06)	3.75 ± 3.59	185.75 ± 164.20
2012	71 (12.84)	4.70 ± 7.78	215.00 ± 112.14	8 (11.27)	2.13 ± 1.00	206.00 ± 118.42	20 (13.42)	3.20 ± 5.96	171.25 ± 121.65	6 (7.59)	4.33 ± 5.28	246.67 ± 104.50
2013	58 (10.49)	5.10 ± 13.56	196.14 ± 101.29	12 (16.90)	1.33 ± 0.89	225.83 ± 83.81	16 (10.74)	4.69 ± 7.55	206.69 ± 102.30	3 (3.80)	11.33 ± 17.04	163.67 ± 29.50
2014	67 (12.12)	3.82 ± 4.06	194.03 ± 106.76	10 (14.08)	1.40 ± 0.97	193.20 ± 104.29	20 (13.42)	1.85 ± 1.31	232.05 ± 102.29	10 (12.66)	1.80 ± 0.92	216.00 ± 109.05
2015	67 (12.12)	5.24 ± 7.54	186.60 ± 103.81	9 (12.68)	2.67 ± 4.27	217.78 ± 121.13	16 (10.74)	2.75 ± 2.18	156.31 ± 120.66	14 (17.72)	3.79 ± 4.35	184.14 ± 111.53
2016	73 (13.20)	5.59 ± 10.02	206.88 ± 104.89	9 (12.68)	1.89 ± 1.97	203.56 ± 119.85	23 (15.44)	2.96 ± 4.79	192.00 ± 99.65	13 (16.46)	4.85 ± 4.74	210.15 ± 116.00
2017	79 (14.29)	5.44 ± 10.10	201.65 ± 110.97	10 (14.08)	1.20 ± 0.42	232.40 ± 120.29	23 (15.44)	4.44 ± 7.13	201.26 ± 116.44	21 (26.58)	3.38 ± 5.36	177.33 ± 96.98



ber of acupuncture treatments for patients aged 0-2 and 13-19 years was 2.64 and 6.39, respectively, and the average number of acupuncture treatments increased with age. Although the frequency of acupuncture was higher in women, the average

rate of use of acupuncture for men and women were similar. Sleep disorder patients received, on average, 3.20 moxibustion treatments during an average follow-up period of 190.98 days. The rate of moxibustion treatment increased with age - from

**Table 4.** Characteristics of patients with nonorganic sleep disorders according to the utilization of conventional and Korean medicine

	Total		CM alone		KM alone	
	n	%	n	%	n	%
Total	1,685	100.00	910	54.01	775	45.99
Age						
0-2	630	37.39	132	14.51	498	64.26
3-5	180	10.68	53	5.82	127	16.39
6-9	140	8.31	62	6.81	78	10.06
10-12	70	4.15	47	5.16	23	2.97
13-19	665	39.47	616	67.69	49	6.32
Gender						
Male	907	53.83	482	52.97	425	54.84
Female	778	46.17	428	47.03	350	45.16
Use of outpatient service						
Mean ± sd	2.63 ± 3.84		2.49 ± 3.67		2.80 ± 4.03	
Median (Q1, Q3)	1 (3, 42)		1 (1, 37)		1 (1, 42)	
Follow-up period (day)						
Mean ± sd	195.81 ± 107.41		188.38 ± 107.76		204.54 ± 106.41	
Median (Q1, Q3)	197 (106, 295)		184.5 (95, 285)		214 (116.5, 303)	
Diagnostic code (except for 2017)						
Nonorganic insomnia	413	27.14	343	42.88	70	9.70
Nonorganic hypersomnia	34	2.23	32	4.00	2	0.28
Nonorganic disorder of the sleep-wake schedule	16	1.05	14	1.75	2	0.28
Somnambulism	29	1.91	22	2.75	7	0.97
Night terrors	575	37.78	145	18.13	430	59.56
Nightmares	31	2.04	26	3.25	5	0.69
Other nonorganic sleep disorders	69	4.53	51	6.38	18	2.49
Nonorganic sleep disorder, unspecified	355	23.32	167	20.88	188	26.04
Year						
2010	260	15.43	114	12.53	146	18.84
2011	254	15.07	132	14.51	122	15.74
2012	228	13.53	124	13.63	104	13.42
2013	193	11.45	89	9.78	104	13.42
2014	214	12.70	120	13.19	94	12.13
2015	192	11.39	111	12.20	81	10.45
2016	181	10.74	110	12.09	71	9.16
2017	163	9.67	110	12.09	53	6.84



5.37% for patients aged 0-2 years to 61.74% for patients aged 13-19 years. In addition, the rate and frequency of moxibustion were higher in women than in men. Sleep disorder patients received, on average, 4.04 cupping treatments during the average follow-up period of 200.98 days. The rate of cupping treatment increased with age: from 10.13% for patients aged 0-2 to 70.89% for patients aged 13-19 years. Furthermore, the proportion of men receiving cupping treatment was higher than that of women, and the frequency of treatments was higher among women.

## 2. Nonorganic sleep disorder

In patients who were diagnosed with nonorganic sleep disorder, rates of utilization of Korean medicine and conventional medicine differed significantly according to age. Among the nonorganic sleep disorder patients aged 0-2 and 3-5 years, 79.05% and 70.56% used Korean medicine and conventional medicine, respectively. In the group of nonorganic sleep disorder patients aged 13-19 and 10-12 years, 92.63% and 67.14%, respectively, used conventional medicine (Fig. 3). Table 4 and 5 list the sociodemographic characteristics and treatment types of patients with nonorganic sleep disorders according to their utilization of medical institution. Among the patients with nonorganic sleep disorders, the patients who used Korean medicine constituted the largest proportion (64.26%) among participants aged 0-2 years, and most were diagnosed with night terrors. Among those who used conventional medicine, the highest proportion of patients were 13- to 19-years-old (67.69%) and were diagnosed with nonorganic insomnia, unspecified nonorganic sleep disorder, and night terrors.

Among the patients with nonorganic sleep disorders who used Korean medicine, 95.74% received acupuncture treatment, on average, 3.31 times during a mean follow-up period of 203.40 days. The average number of acupuncture treatments for the patient groups aged 0-2 and 13-19 years was 2.84 and 8.00, respectively. Among patients with nonorganic sleep disorders, 9.55% received moxibustion treatment, on average, 3.62 times during a mean follow-up period of 209.27 days. For patients who were older than 6 years, the rate of moxibustion was more than 20.51%. In the group of patients with nonorganic sleep disorders, 9.03% received cupping treatment, on average, 3.61 times over an average follow-up period of 210 days. The proportion of patients aged 0-2 years who underwent cupping was 7.63%, who which was undertaken on average 4.34 times during an average follow-up period of 210.37 days. Among those

aged 13-19 years, 32.65% underwent cupping, on average, 3.38 times during a mean follow-up period of 162.06 days. Of the patients with nonorganic sleep disorders, 7.87% received herbal medicine treatment, on average, 1.39 times during a mean follow-up period of 209.07 days.

## DISCUSSION

Using HIRA data that were collected from 2010 to 2017, this study estimated the prevalence of sleep disorders and nonorganic sleep disorders in Korean children and adolescents, the type of medical utilization, and the type of Korean medicine treatment. The patients with sleep disorders who used conventional medical institutions were mainly adolescents aged 13 years or more, were more likely to be male, and were diagnosed with insomnias, sleep apnoea, and unspecified sleep disorders. Moreover, patients with nonorganic sleep disorders who used conventional medical institutions were mainly adolescents aged 13 years or more, and more male participants were diagnosed with nonorganic insomnia, night terrors, and unspecified nonorganic sleep disorders. Sleep disorder patients who used Korean medical institutions mainly comprised children aged 0-5 years, and the majority were diagnosed with insomnias (71.02%). In addition, non-organic sleep disorder patients who used Korean medical institutions were mainly children aged 0-5, and most were diagnosed with night terrors (59.56%). Most patients with sleep disorders or nonorganic sleep disorders who used Korean medical institutions received acupuncture treatment (91.84%), and some patients received moxibustion (15.82%), cupping (10.57%), and herbal medicine treatment (9.35%).

Few studies have examined the prevalence of sleep disorders and nonorganic sleep disorders among Korean children and adolescents, and the majority have targeted specific populations. Therefore, the results of previous studies cannot be compared directly with those of this study. In addition, the prevalence of sleep disorders and nonorganic sleep disorders in the ROK is often reported to be lower than that of other countries. The reported prevalence of insomnia, based on an interview with Korean children, was 16% [8], and the estimated prevalence of insomnia that was determined through insurance data was 0.4% [12]. Early diagnosis and treatment of sleep disorders in children are vital to prevent behavioral disorders and learning disabilities [5]. Despite the significant impact of sleep disorders on children and adolescents, the utilization of medical institu-

**Table 5. Treatment type of patients with nonorganic sleep disorders according to the utilization of Korean medicine**

	Acupuncture			Herbal medicine			Moxibustion			Cupping		
	n (%)	N of prescription mean $\pm$ sd	Follow-up period mean $\pm$ sd	n (%)	N of prescription mean $\pm$ sd	Follow-up period mean $\pm$ sd	n (%)	N of prescription mean $\pm$ sd	Follow-up period mean $\pm$ sd	n (%)	N of prescription mean $\pm$ sd	Follow-up period mean $\pm$ sd
Total	742 (100.0)	3.31 $\pm$ 5.86	203.40 $\pm$ 106.82	61 (100.0)	1.39 $\pm$ 1.04	209.07 $\pm$ 108.75	74 (100.0)	3.62 $\pm$ 6.34	209.27 $\pm$ 113.88	70 (100.0)	3.61 $\pm$ 5.30	210.47 $\pm$ 106.43
Age												
0-2	484 (65.23)	2.84 $\pm$ 3.55	205.28 $\pm$ 106.34	32 (52.46)	1.44 $\pm$ 0.95	221.44 $\pm$ 104.29	26 (35.14)	2.69 $\pm$ 5.22	199.00 $\pm$ 11.07	38 (54.29)	4.34 $\pm$ 5.48	210.37 $\pm$ 98.65
3-5	120 (16.17)	2.86 $\pm$ 5.09	197.53 $\pm$ 103.60	12 (19.67)	1.17 $\pm$ 0.39	209.25 $\pm$ 104.61	8 (10.81)	6.25 $\pm$ 14.45	244.50 $\pm$ 104.81	7 (10.00)	2.14 $\pm$ 2.19	252.43 $\pm$ 103.82
6-9	71 (9.57)	4.01 $\pm$ 7.94	203.68 $\pm$ 119.80	8 (13.11)	1.13 $\pm$ 0.35	195.38 $\pm$ 139.28	16 (21.62)	3.75 $\pm$ 5.34	245.25 $\pm$ 119.55	8 (11.43)	1.63 $\pm$ 1.06	263.88 $\pm$ 54.72
10-12	21 (2.83)	4.00 $\pm$ 3.81	205.57 $\pm$ 88.81	4 (6.56)	1.00 $\pm$ 0.00	210.25 $\pm$ 121.91	6 (8.11)	2.50 $\pm$ 3.21	173.67 $\pm$ 86.00	1 (1.43)	6.00	268.00
13-19	46 (6.20)	8.00 $\pm$ 15.16	197.46 $\pm$ 110.14	5 (8.20)	2.40 $\pm$ 2.61	150.40 $\pm$ 109.69	18 (24.32)	4.06 $\pm$ 3.62	188.33 $\pm$ 123.93	16 (22.86)	3.38 $\pm$ 6.91	162.06 $\pm$ 131.64
Gender												
Male	406 (54.72)	3.36 $\pm$ 6.57	205.38 $\pm$ 105.15	25 (40.98)	1.28 $\pm$ 0.84	194.36 $\pm$ 109.31	36 (48.65)	3.00 $\pm$ 3.42	194.69 $\pm$ 105.97	35 (50.00)	3.57 $\pm$ 5.22	190.37 $\pm$ 92.81
Female	336 (45.28)	3.25 $\pm$ 4.87	201.00 $\pm$ 108.91	36 (59.02)	1.47 $\pm$ 1.16	219.28 $\pm$ 108.72	38 (51.35)	4.21 $\pm$ 8.21	223.08 $\pm$ 120.66	35 (50.00)	3.66 $\pm$ 5.46	230.57 $\pm$ 116.37
Diagnostic code												
Nonorganic insomnia	67 (9.03)	5.09 $\pm$ 10.09	186.02 $\pm$ 110.13	12 (19.67)	1.75 $\pm$ 1.77	148.75 $\pm$ 90.65	17 (22.97)	3.88 $\pm$ 4.53	169.00 $\pm$ 118.86	12 (17.14)	2.08 $\pm$ 1.78	136.50 $\pm$ 110.71
Nonorganic hypersomnia	2 (0.27)	5.50 $\pm$ 3.54	93.00 $\pm$ 25.46	0 (0.00)			1 (1.35)	4.00	111.00	0 (0.00)		
Nonorganic disorder of the sleep-wake schedule	2 (0.27)	1.50 $\pm$ 0.71	150.50 $\pm$ 202.94	0 (0.00)			1 (1.35)	1.00	7.00	1 (1.43)	1.00	7
Somnambulism	7 (0.94)	4.00 $\pm$ 3.46	175.71 $\pm$ 58.53	1 (1.64)	1.00	139	2 (2.70)	1.00	156.00 $\pm$ 31.11	0 (0.00)		
Night terrors	418 (56.33)	2.62 $\pm$ 3.22	198.78 $\pm$ 107.20	29 (47.54)	1.35 $\pm$ 0.94	221.55 $\pm$ 107.23	24 (32.43)	2.38 $\pm$ 3.33	214.38 $\pm$ 107.75	17 (24.29)	2.47 $\pm$ 1.94	194.35 $\pm$ 88.57

**Table 5. Continued**

	Acupuncture			Herbal medicine			Moxibustion			Cupping		
	n (%)	N of prescription mean ± sd	Follow-up period mean ± sd	n (%)	N of prescription mean ± sd	Follow-up period mean ± sd	n (%)	N of prescription mean ± sd	Follow-up period mean ± sd	n (%)	N of prescription mean ± sd	Follow-up period mean ± sd
Nightmares	4 (0.54)	6.00 ± 4.69	190.75 ± 108.48	1 (1.64)	1.00	53	0 (0.00)	0 (0.00)	0	0	0	0
Other nonorganic sleep disorders	16 (2.16)	1.75 ± 1.13	237.81 ± 93.73	1 (1.64)	1.00	332	2 (2.70)	1.00	249.50 ± 115.26	1 (1.43)	1.00	168
Nonorganic sleep disorder, unspecified	178 (23.99)	4.10 ± 8.04	215.54 ± 106.53	14 (22.95)	1.36 ± 0.50	240.07 ± 113.03	23 (31.08)	3.96 ± 5.96	238.13 ± 113.44	33 (47.14)	5.09 ± 7.26	234.55 ± 99.66
Year												
2010	143 (19.27)	2.48 ± 2.80	187.47 ± 104.79	14 (22.95)	1.14 ± 0.36	179.43 ± 103.44	8 (10.81)	2.88 ± 3.83	195.00 ± 108.78	5 (7.14)	2.00 ± 2.24	153.40 ± 95.15
2011	115 (15.50)	2.37 ± 2.80	206.08 ± 99.06	10 (16.39)	1.40 ± 0.97	221.90 ± 121.73	8 (10.81)	2.13 ± 2.10	203.38 ± 113.76	2 (2.86)	1.50 ± 0.71	245.00 ± 108.89
2012	102 (13.75)	3.70 ± 7.74	200.55 ± 107.26	8 (13.11)	1.88 ± 2.10	176.75 ± 90.08	10 (13.51)	2.60 ± 2.91	186.50 ± 125.07	8 (11.43)	1.63 ± 0.92	136.50 ± 102.26
2013	100 (13.48)	3.82 ± 7.19	199.50 ± 100.80	6 (9.84)	1.17 ± 0.41	239.33 ± 133.91	11 (14.86)	3.55 ± 5.36	166.64 ± 97.63	12 (17.14)	4.58 ± 5.71	210.50 ± 84.00
2014	91 (12.26)	3.98 ± 4.68	206.78 ± 113.81	6 (9.84)	1.83 ± 0.60	242.50 ± 89.76	13 (17.57)	3.31 ± 4.29	200.08 ± 146.08	10 (14.29)	2.50 ± 2.07	156.40 ± 125.67
2015	73 (9.84)	2.80 ± 3.52	198.93 ± 113.66	8 (13.11)	1.50 ± 0.76	209.63 ± 127.17	12 (16.22)	2.25 ± 2.26	203.25 ± 92.68	18 (25.71)	3.06 ± 2.73	207.78 ± 97.38
2016	70 (9.43)	4.39 ± 9.96	227.86 ± 115.19	6 (9.84)	1.17 ± 0.41	230.33 ± 122.32	8 (10.81)	6.00 ± 8.98	312.38 ± 58.00	9 (12.86)	8.44 ± 11.60	297.56 ± 77.69
2017	48 (6.47)	4.10 ± 6.71	223.31 ± 102.60	3 (4.92)	1.00	219.33 ± 111.50	4 (5.41)	11.25 ± 20.50	265.50 ± 110.62	6 (8.57)	2.67 ± 1.63	312.67 ± 40.84

tions is low. Parents and patients tend to regard sleep disorders as personal problems or ignore them because of the children's schoolwork [13]. Therefore, they are not interested in health problems caused by sleep [14].

Nonorganic sleep disorder is diagnosed based on the subjective experiences of the patients [15] and includes behavioral and mental disorders as well as parasomnias and dyssomnia [16]. Night terrors are the most frequently diagnosed disease in Korean medical institutions among patients with nonorganic sleep disorders (59.56%) and are characterized by extreme fear, panic, and signs of the autonomic nervous system related to extreme vocalization and motility [17]. Night terrors do not recommend medical intervention, but clonazepam may be considered for severe symptoms [18]. Clonazepam may cause excessive sedation, and parents of patients with nonorganic sleep disorders in the 0-5 age group may be reluctant to use clonazepam [19]. Therefore, it can be inferred that Korean medicine treatment, which has few adverse effects, is preferred over pharmacotherapy [20, 21].

Among patients with sleep disorders and nonorganic sleep disorders who used Korean medical institutions, 91.84% received acupuncture treatment, which is effective for treating insomnia and the associated complications as well as has few adverse effects [22]. Furthermore, lack of sleep can cause pain, and acupuncture is an effective treatment for pain caused by a lack of sleep. The mechanism of acupuncture treatment for sleep disorders improves the quality of sleep by normalizing the release of serotonin and melatonin and, through the inhibition of inflammatory cytokines, alleviates pain induced by lack of sleep that is caused by the anti-inflammatory effect [23]. However, the low level of evidence because of the low methodological quality of the studies is a limitation [24].

This study has several strengths and limitations. This study is the first to compare the trends of conventional medicine and Korean medicine utilization by classifying sleep disorders and nonorganic sleep disorders in Korean children and adolescents based on representative data extracted from the insurance data collected from the entire Korean population. Furthermore, this is the first study to analyze the types of Korean medicine treatment for children and adolescents with sleep disorders and nonorganic sleep disorders. Nevertheless, this study has the following limitations. First, this study compared the sociodemographic characteristics and medical utilization trends of children and adolescents with sleep disorders and nonorganic sleep disorders. Therefore, it is not possible to estimate health

outcomes using medical institutions. In addition, the maximum follow-up period was 1 year. Therefore, a study on the medical use trend according to the long-term follow-up period will be necessary. Also, since this study was analyzed using annual insurance data, it may have underestimated the number of patients who used both conventional medicine and Korean medicine. Second, treatments that were not covered by insurance are likely to be underestimated and includes most herbal medicine treatments. In addition, cognitive behavioral therapy, which is recommended as the first-line treatment for insomnia, was not covered in this study because insurance coverage was applicable after 2018. There is little insurance data on Korean medicine psychotherapy because only a few specialists provide Korean medicine psychotherapy. Third, "night crying", defined by Korean medicine, was excluded because it was difficult to distinguish it from night terrors with the KCD [25]. According to KCD, "night crying" was integrated into R68.1, which included "excessive crying of infant", "irritable infant", and "fright seizure disorder". Future studies of "night crying" are needed.

## CONCLUSION

This study reported the prevalence of sleep disorders and nonorganic sleep disorders and the use of medical institutions among Korean children and adolescents. In addition, this study showed the type of Korean medicine treatment that these children received for sleep disorders and nonorganic sleep disorders. Patients with sleep disorders and nonorganic sleep disorders significantly differed in their use of medical institutions according to their age. Sleep disorders are prevalent among Korean children and adolescents, but the use of medical utilization is low. Policy efforts are needed to ensure that children and adolescents with sleep disorders receive appropriate treatment. Future research will be needed to provide appropriate treatment to patients with sleep disorders in conventional and Korean medicine.

## CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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## AUTHORS' CONTRIBUTIONS

Conceptualization, JW Lee and MK Hyun; methodology, JW Lee, JS Hwang, and MK Hyun; formal analysis, JW Lee; writing - original draft, JW Lee and MK Hyun; writing - review & editing, JW Lee, JS Hwang, and MK Hyun; supervision and project administration, MK Hyun. All authors have read and agreed to the published version of the manuscript.

## ETHICAL STATEMENT

This study was approved by the Institutional Review Board of Dongguk University, Gyeongju (DRG IRB 20200021-01). Patient consent was exempted because of the total anonymity of all research data used in this study.

## DATA AVAILABILITY

The datasets generated during and analyzed in the current study are available in the HIRA-NPS repository. The study used HIRA-NPS data (2010-2017), which are third-party data and thus not owned by the authors. The HIRA data are available on direct request, via email or fax, and submission of the request form and declaration of data use, which are downloadable from the HIRA website (<http://opendata.hira.or.kr>), and upon payment of a data request fee (300,000 KRW per dataset).

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